DOCUMENT RESUME

ED 031 907 EF 003 382

Movement and Growth Patterns and Their Effect on the Spatial Organization of Colleges. Colleges of Applied Arts and Technology.

Ontario Dept. of Education, Toronto. School Planning and Building Research Section.
Pub Date 69
Note-29p.
EDRS Price MF-$0.25 HC-$1.55
Descriptors-Campus Planning, Climatic Factors, *College Planning, *Colleges, *Growth Patterns, Master Plans, *Organization, Pedestrian Traffic, Site Analysis, *Spatial Relationship

Layouts of the campuses of nine American, English and Canadian universities show how five types of growth patterns (axial, linear, radial, precinctual and cellular/grid) provide for flexibility in expansion. The site of the campus, a major influence in growth patterns, is discussed from the aspects of location, accessibility, physical characteristics, and climate. Pedestrian and vehicular movement patterns are also illustrated and discussed. Plans and descriptive diagrams develop the theme throughout. (RK)

ED031907

Colleges of Applied Arts and Technology

MOVEMENT AND GROWTH PATTERNS and their effect on the spatial organization of colleges

EF 003 382

prepared by
School Planning & Building Research Section
Ontario Department of Education and
John Sullivan, MRAIC, MTPIC, ARIBA
Leman-Sullivan, architects and planners

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

© Ontario Department of Education/Toronto 1969

"PERMISSION TO REPRODUCE THIS COPYRIGHTED MATERIAL HAS BEEN GRANTED BY School Planning + Building Research Section, Ontario Dept of Education [S.T. Orlowski] TO ERIC AND ORGANIZATIONS OPERATING UNDER AGREEMENTS WITH THE U.S. OFFICE OF EDUCATION. FURTHER REPRODUCTION OUTSIDE THE ERIC SYSTEM REQUIRES PERMISSION OF THE COPYRIGHT OWNER."

PREFACE

Colleges of Applied Arts and Technology must be considered part of the total educational system. Here a select group of students, who have completed the secondary education level, are provided with academic and professional qualifications for different specializations. A functional classification of colleges can be arrived at by grouping them according to the manner in which they control the educational process.

In this report the discussion will be limited to consideration of some of the physical consequences resulting from the academic program divisions. The intent is to illustrate the complexity involved in planning new colleges, and the reader should remember that decisions in any one area will bear a relation to policies in other areas and, therefore, must be carefully evaluated in that context.

It is impossible to isolate the academic program and the social policy since the aims of higher education apply to the economic, social and cultural welfare of a community. "A university should provide an experience of living as well as the opportunity for learning — without this, education is dehumanized, the student himself defrauded . . . ."[1] In describing the aims of higher education in Great Britain, the Robbins Committee said, "there is a function that is more difficult to describe concisely, but that is none the less fundamental: the transmission of a common culture and common standards of citizenship."[2]

A view of a student's life is to provide a milieu for education, for living, learning, and sharing that involves the teaching facilities, the social facilities and his place of residence. Decisions concerning one sphere will have a major influence on the others, both in relation to the campus and the community as a whole.

The scope of this paper will be limited to the teaching facilities. The campus site is being examined here without consideration of the larger community. In reality, however, the community must be considered in all aspects of campus planning. The importance of the relationships of the campus to the community and of the residential and social facilities to the academic must always be considered.

CONTENTS

Types of Academic Structures	3
Tutorial	3
Departmental	4
Supra-Departmental	4
Spatial Organization	5
Site	6
Location	6
Accessibility	6
Physical Characteristics	6
Climate	7
Growth Patterns	8
Flexibility	8
Types of Growth Patterns	9
Axial	9
Linear	12
Radial	15
Precinctual	18
Cellular Grid	20
Movement Patterns	23
Vehicular	23
Information	23
Services	23
Pedestrian Movement	24
Axial	24
Linear	25
Radial	27
Precinctual	27
Cellular Grid	27

Traditional Oxbridge College, England

TYPES OF ACADEMIC STRUCTURES

Tutorial

The architectural expression of an academic structure is well illustrated in the traditional Oxford/Cambridge Colleges. The considerable emphasis these colleges place on the social as well as the intellectual aspects of higher education is reflected in the building forms. The basic concept of social grouping is a function which finds its expression in the courtyard form. The courtyards furnish a framework within which dissimilar elements — places of residence, dining hall and chapel — can be easily related. The quandrangle form, with building heights limited to walk-up distances, provides an aesthetically pleasing vernacular. The courtyard form furnishes a principle of growth whereby elements can be easily added to the chain over the years without disrupting the social pattern and visual harmony.

The concept of social groupings is particularly well delineated in three-dimensional form at Cambridge. The courtyard defines a community of scholars and provides access to various staircases. The movement of people diagonally across the rectangular green creates an animation quite different from movement through the peripheral arcades of a monastic cloister. The staircases are the cores of smaller social groupings in a larger complex. The sub-grouping usually consists of a set of service rooms at the entry, a fellow in residence on the lower level and scholars above ranged off a series of landings and vestibules, a system which generates a high degree of personal contact. Traditionally, there are no internal corridors. Architecturally, this allowed a relating of units of different height.

The new universities of York in England and Santa Cruz in California have adopted the Oxbridge Tutorial approach as the basis of their academic structure. The structure is reflected in the nodal characteristics of their master plans. However, since neither has used the courtyard form of building, they provide convenient examples with which to illustrate the variety of architectural interpretations which can be given to similar academic structures.

Some educators believe that audio-visual teaching aids and computers will give rise to an increase in tutorial-centred programs. Ideally, this would allow each individual to follow his own unique course of study; teaching machines, unlike teachers, would be available for unlimited periods, at any time, and social situations resulting from the regularized movement through commonly shared spaces would be less frequent. Therefore, the structuring of informal social patterns would be of the utmost importance.

Departmental

The departmental academic structure has its own roots in the German tradition of stressing the teaching and research roles of higher education. This is the basis of the academic program of most colleges and universities founded in the nineteenth century, hence it is the traditional organizational pattern adopted by most American, Canadian and English universities. A department is devoted to the teaching of a particular subject and is headed by a dean or chairman. The size of individual departments may vary greatly. The department's primary function is the teaching of its own students. Interaction with other disciplines is often limited to the service teaching of students from other departments and of students who may be following a multi-subject course. In many cases the department contains its own accommodation — lecture rooms, offices, research facilities and even libraries and lounges. The autonomous nature of many university departments is shown by their individual edifices, for example, the Department of Mathematics Building.

Students are taught in groups at fixed times. This involves the movement of students from teaching space to teaching space at regulated intervals. The movement patterns of the students provide the connection between departments. Hence, the linkages between the major departments on campus become an important factor in master planning. Central facilities, such as library and administration offices and social facilities, such as the union are usually located at the points of maximum confluence. Frequently, residential accommodation is placed at a peripheral location. The traditional campus plan expression of this academic structure is the quadrangle green.

Supra-Departmental

At present, many educators are creating academic programs on a modified departmental basis. The overlapping and interaction between disciplines is seen to be intellectually stimulating in that it combines the study of a specialty with the understanding of its general organization. The broader approach avoids creating artificial barriers between subjects that are best treated together. From the administrative point of view there may be less wastage of academic space, and fewer conflicts and frustrations in an integrated system than in a rigid departmental system. Architecturally, this is expressed in campus plans and structures which are designed to encourage both formal and informal interaction between disciplines and people. Common libraries and lounges may provide both formal and informal mixing and studying situations. Informal meetings can be encouraged by the careful design of pedestrian circulation systems which invite students and staff to withdraw from the main stream of traffic into settings designed for conversation.

In some instances, the withering away of separate departments and the creation of wider fields of study have led to a complete reorganization and restructuring of the campus spaces in terms of functional activities. The University of Illinois' Chicago Circle Campus is an example of this type of arrangement. Here, all faculty offices are located in a tower block at the entrance to the site and all the large lecture spaces are grouped together in the centre of the site. The result is a maximum mixing of disciplines in the formal classroom spaces. However, the physical segregation of faculty offices has made student-teacher contact difficult.

When this approach is used in conjunction with computer time-tabling, major savings in faculty time and building space should be achieved. One of the dangers of the system is that the student may operate in an unstructured world and suffer from a loss of orientation and identity. There is no three-dimensional echo of his course of study and there is no home base with which to identify. The student operates from a locker if he commutes, or a bedroom if he lives near the academic buildings. The liberal provision of carefully located social spaces throughout the campus becomes vitally important.

SPATIAL ORGANIZATION

Although the type of academic program will indicate principles to be followed in the spatial organization of the campus, there can be no single master plan expression of an academic program. Nor, for that matter, does the physical arrangement of a campus preclude the future restructuring of the academic philosophy.

Certain basic considerations in the spatial organization of a campus are common to all types of master planning. The initial decisions taken regarding the distribution of activities will have a fundamental effect on the acceptable movement and growth patterns of the college.

The hierarchy of activities is the single strongest organizational force in master planning. The central location in the campus plan is usually reserved for those activity spaces that are most frequently used by all members of the collegiate community. Towards the periphery there is a gradual decrease in density to those activity spaces used by the fewest numbers for the longest periods of time. The same approach is used in campuses planned by the tutorial model. However, in this type of campus, the overall complex is usually first divided into sub-groupings. The hierarchy of activities is then applied to the arrangement of the sub-groupings. Even with this type of allocation there are usually facilities which are shared by the total complex.

The activity spaces that tend to be centrally located are teaching facilities of a high density and high change-over frequency such as auditoriums, lecture theatres, audio-visual labs and non-teaching facilities such as libraries, administrative offices, indoor athletics, lounges, common and dining rooms. On the periphery specialized teaching spaces, highly serviced areas, research labs and faculty offices are located.

In a campus site of restricted dimensions, the organization should be developed on vertical as well as horizontal planes, and the periphery may produce higher levels.

The library has been called the most vital piece of equipment in the university. Policy decisions concerning the organization of the library facilities are directly related to the academic structure and are very important in determining the pattern of social interaction. The location and type of library facilities should be considered a critical factor in analysing possible growth and movement patterns.

SITE

The site of the campus will exert a strong influence on the growth and movement patterns of the college complex. The factors affecting the selection of the site should be the subject of a separate provincial and regional study.

Location

The primary consideration resulting from the choice of site is the relationship of the campus to the community. This relationship involves the extra-curricular role of the campus in the community, going beyond its primary educational function and the community's role in the functioning of the campus. The community's role is usually social, providing gathering places, residential accommodation, and economic support for the college and the students.

New campuses tend to be located in the countryside. The practical reasons of location are obviously influenced by campus growth. Higher education facilities require a range of flexibility which is more easily developed in a non-urban location. Campuses do not develop in an orderly manner that can be neatly phased with the obsolesence of existing buildings on the borders of an urban site. However, physical removal from the community may also imply a subtle kind of segregation from every-day life which may not be healthy for either the academic or the secular community.

Accessibility

No matter how great the degree of segregation, the campus and the community are linked by transportation systems. The policies of the college and community must be carefully coordinated in this field. For example, if the campus delegates its residential role to the community (as it does entirely in commuter campuses), easy access to the campus must be provided. If this is to be entirely by private cars, the road system of the community must be able to handle the traffic without causing congestion. If public transport facilities are to be used they must be capable of bearing the load. An example of this inter-relationship is shown in the Manchester Educational Precinct Report. Initially, the university intended that a large percentage of students would live at home and commute to campus by bus. Studies showed that it would be impossible to accommodate sufficient bus space on the city's streets. As a result, the university increased the amount of residence facilities and of student parking on the site, and the city re-routed a proposed rapid transit route (monorail) through the campus. As a result the university was able to carry ahead its plans for expansion to meet the demands of increasing enrolment.

To a greater or less extent every university is faced with the problem of automobiles: how many to allow in, and where to put them. It is interesting that a high degree of pedestrian and vehicular segregation is not only accepted but often demanded by higher education institutions. Existing colleges and universities, planned along a normal street system, are trying a variety of methods to exclude cars from at least a part of the campus.

Physical Characteristics

Each site has its unique physical characteristics — sub-soil conditons, topography, landscape and micro-climate — which must be carefully evaluated in the spatial organization of a campus. Adverse sub-soil conditons may necessitate costly building foundations, limit the economically feasible weight of the structure, or even prohibit construction on part of the site.

The master plan and the architect's structures must be in harmony with the topography. Certain land forms may generate a particular type of development. The slope of the land is a factor affecting movement. Dramatic variations in the contours may limit growth. This is not to say that a flat site is preferable to a sloping one. It is the responsibility of the architect to exploit the natural characteristics of any site and to exploit natural desirable features economically. There

may be trees, shrubs, wild flowers, etc., that can be utilized to create a natural feature on the campus. Additional planting, excavation and earth movement may augment existing features but the landscaping needs to be planned as imaginatively as the architecture. It should be treated as a positive design element and not be merely an afterthought.

With our urban patterns of living the micro-climate of a particular site is an almost forgotten factor. However, farmers still know it well; they realize that land forms create localized air flows that protect some portions of ground and expose others. This is more obvious on a site with well moulded contours but is of equal importance on the plains. The effect of buildings on the micro-climate is just beginning to be recognized. For example, tower blocks accelerate and reverse the wind direction at ground level. In some cases, the pedestrian plazas so carefully squeezed in at the base of office towers are uninhabitable.

At San Mateo College in San Mateo California, pedestrian paths are canopied for weather protection. They provide shade in hot weather but create edies of air which sweep rain under them. The effects of man-made structures on the movement of air is difficult to predict. Architects are utilizing wind tunnels in order to test models for desired conditions of shelter or exposure.

Climate

Precipitation, temperature ranges and prevailing winds, considered in relation to the use of the buildings, will impose design conditions on outdoor and indoor paths of movement.

A severe climate reduces acceptable outdoor walking distances. For example, a number of years ago Northwestern University built a large classroom building several blocks from the rest of their teaching facilities. The students had to walk along the edge of Lake Michigan to reach the building. During winter, the wind blowing off the lake made walking agony, and the students soon learned to avoid registering for winter classes located in that building. Recent expansion of the campus has been made by land fill into the lake. The large classroom building is no longer isolated and the new construction shelters the pedestrian path which is no longer on the water's edge, with the result that students no longer shun classes in the building.

The degree of protection required for pedestrian movement in a climate as variable as Canada's is difficult to agree upon. Changing standards of living have tended to decrease walking time in very cold or very hot weather. It is likely that this trend will continue. Alternately, some people find contact with the natural climate psychologically invigorating. The use of climate controlled spaces for pedestrian movement will undoubtedly continue to increase but it is highly desirable that alternative external routes also be provided.

GROWTH PATTERNS

Flexibility Considerations

Types of Change to be Accommodated

No final outcome can be predicted for a college campus. Estimates of ultimate size are of limited value in long-term planning, when academic policy changes may affect both the physical and social structure of the college, and technological advances may provide new means of sheltering, servicing, transporting, and educating the learning community. The planning process must be kept flexible, ready to adapt to academic, social and technological changes, yet at all times retaining an overall plan for the college as a coherent entity.

Change in Scale

A flexible system of organization must be found that will permit a variety of types of change. The obvious type is a change in scale — that is, in the number of students enrolled. This may be caused by a significant variation in the population of the college's basic catchment area, or changing social standards and employment needs. Although change in scale is now associated with an increase in student enrolment, this has not always been true. In the past, crises such as the depression, World War II and the Korean War have caused a decrease in total student enrolment and a significant change in the male female student ratio and, hence, a change in the demand for particular courses.

Changes in Organization

Higher education is in a state of flux. The methods employed in teaching and the needs which they satisfy are changing and this affects the organization of the academic program which in turn, affects the location, type and size of the campus components and their linkages. It is difficult to forecast the exact nature of changes that will need to be accommodated. Increasing specialization may demand a provision of smaller units, yet trends toward inter-departmental organization may indicate larger units. The widespread use of electronic teaching aids may cause a revolution in the basic concepts of the organization of the academic program. The physical effect of TV links between teachers and students on the physical form of higher educational facilities is difficult to foresee.

Change in Groupings

Social and technological developments may make traditional and contemporary groupings obsolete. For example, in terms of both academic program and physical facilities, science courses are frequently separated from arts courses. In the future this may not be a valid division of disciplines.

Obsolescence

Over the course of years, buildings deteriorate and will require replacing. Changes in scale, organization and grouping may result in buildings becoming unsuitable for their original functions. Flexibility as a criterion in design could help to forestall obsolescence although general economic conditions tend to delay or accelerate it.

Growth and change in Buildings

"The subject of growth and change in buildings is one that has recently received considerable attention from architects and planners . . . Although some writers have tended to attribute to buildings almost organic properties of growth, and have suggested typical growth curves and life spans for certain building types, it is worth remembering that additions and alterations to buildings are made quite simply in response to the needs of the organization which they house — for example, increases in population, changing activities or changing space standards -- and that the root causes of building growth, and change must be sought at these levels. A building is bound to be added to or extended in large increments, and the total area of accommodation increases in a series of steps, while population tends to grow at a steadier rate . . . this has consequences on the varying pattern of under and over utilization throughout the building's history."[3]

Flexibility Criteria

It is difficult however, to define criteria for flexibility in a master plan. The following factors in the organization of physical elements should be considered:

— Through the campus there should be a maximum freedom of association, choice and communication for students, faculty and staff.

— Each phase of the developing campus should be capable of functioning efficiently and not depend on further growth taking place.

— The campus should be capable of growth without deformation or distortion.

— Further phases should be planned in such a way that they will not interfere with the existing campus.

— The master plan should allow for the change and renewal of its elements.

— At the design stage the multi-use and adaptability of spaces and changes of function of spaces should be provided for.

— Adaptation of transportation systems and parking accommodation to changes in campus organization.

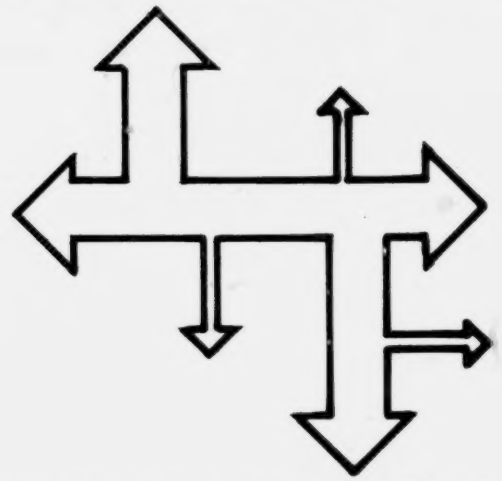
Types of Growth Patterns

In the following sections several types of campus plans are examined in relation to their growth patterns as caused by an increase in scale.

Axial

An axial pattern of growth is used so frequently in the development of campus master plans, that it might be referred to as the traditional plan. The basic organizing principle is a central axis or space around which buildings are arranged. A central space, spine, mall or quadrangle is the organizing feature around which other structures and areas are arranged. The axial pattern starts with a core building which, in the early stages, may house the whole university. Extension from this firmly established centre grows along the axes established by the central space. It should be possible to move the centre of activity as development takes place.

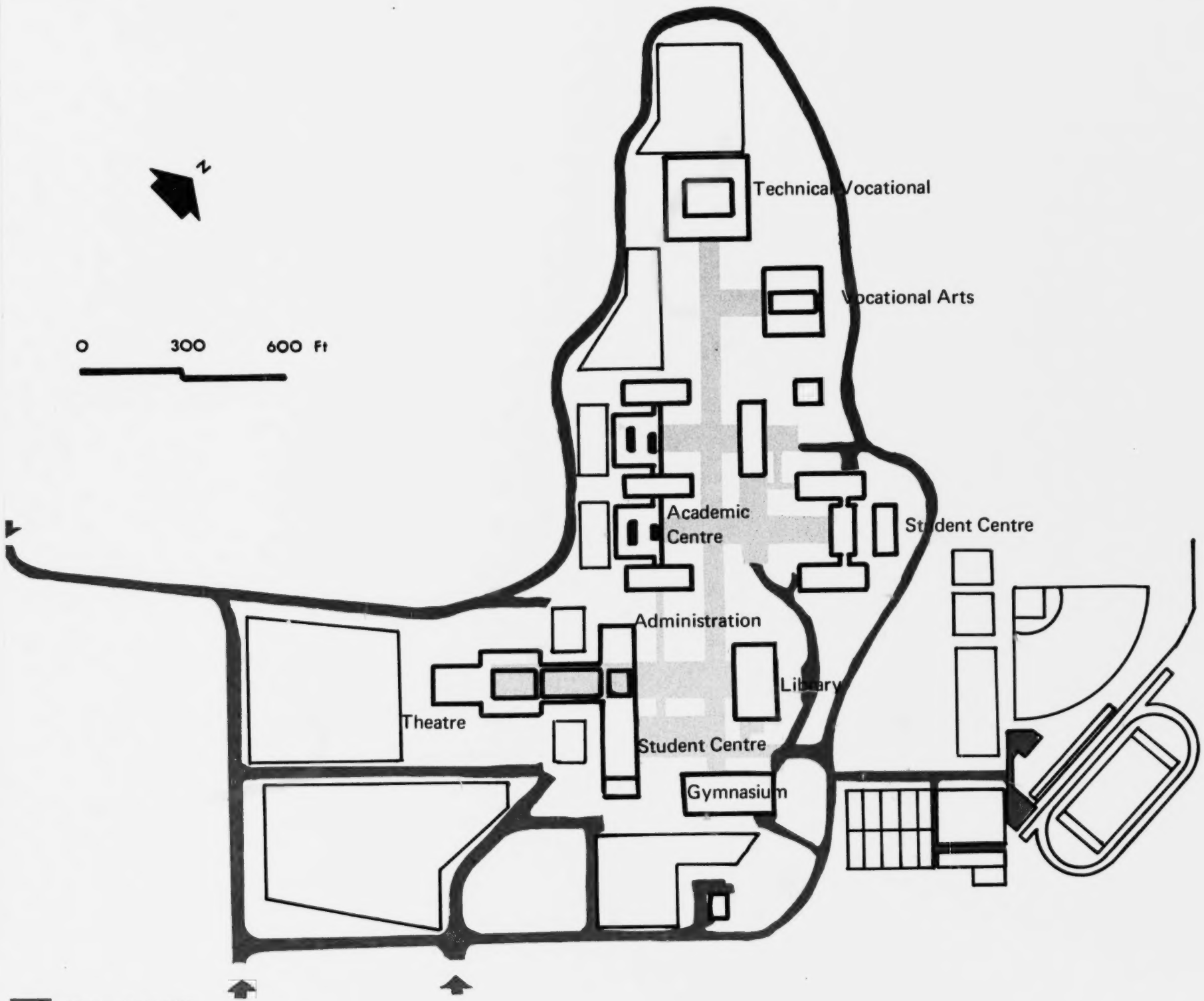
The term axial implies one dominant growth and movement pattern. In addition, there are usually secondary paths of growth. The traditional use of the axial growth principle has been applied to a departmental academic program. Each discipline is housed in a separate building; allowing the department to grow outwards from the major axis. Piecemeal development is simple since each new addition can be an individual building which is related to the total complex only at the point where it contacts the pedestrian mall. There is a danger that this arrangement may lead to an undesirable separation of interrelated disciplines.



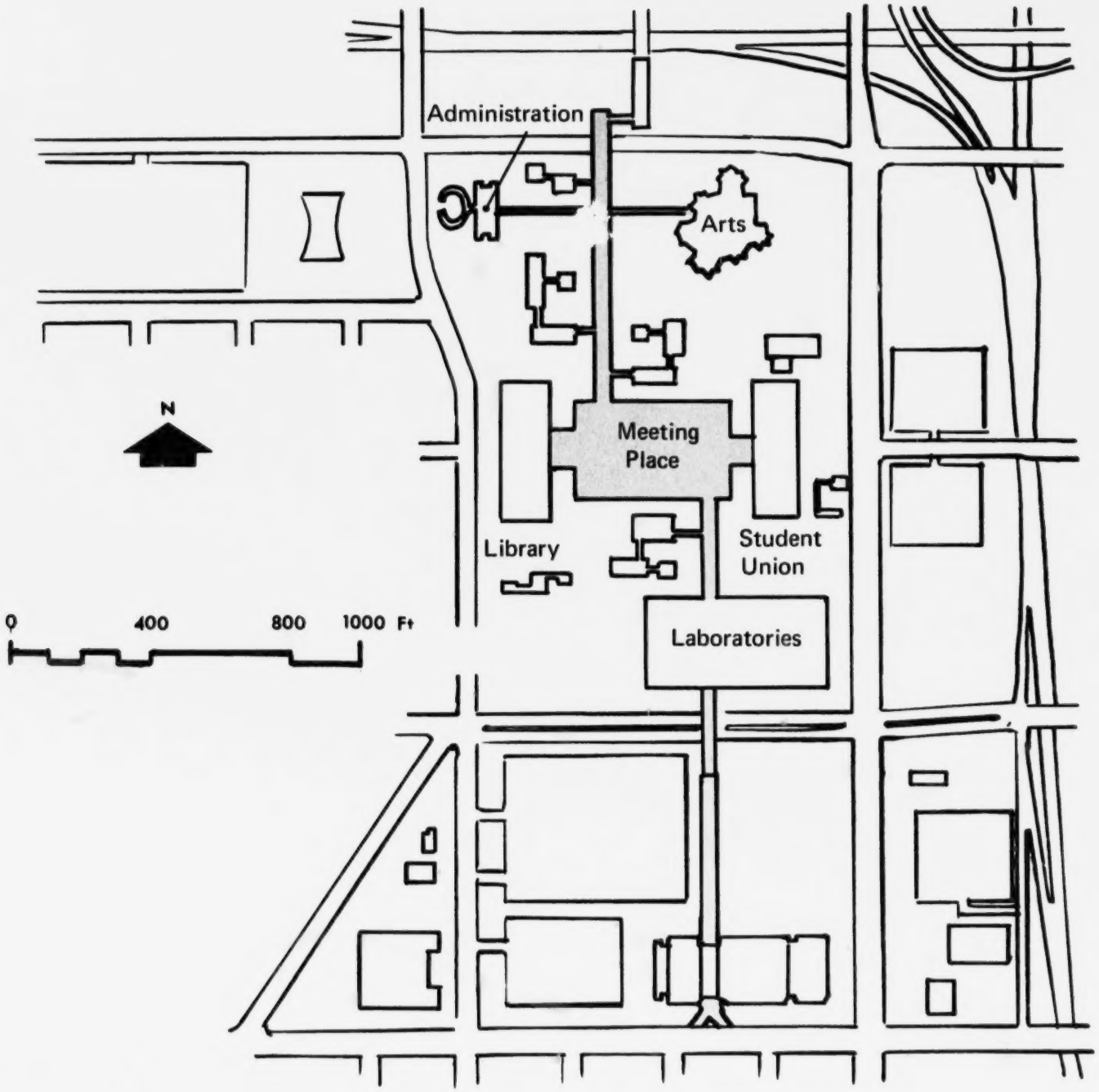
The core of this type of campus is defined by the locus of greatest student concentration. At San Mateo Junior College, the two pedestrian malls which form principle axes intersect in front of the administration building, gymnasium, library and student centre. The other buildings are located along the axes according to academic affinity. As you move outwards from the core there is less communication. In this example, parking and sports fields are found on the periphery, since longer periods of time are spent in sports — several hours or the afternoon rather than fifty minutes as for a lecture. There is contact with a car only twice during one's stay on campus — on arrival and on departure. By designing roads in a periphery loop and providing parking at this point, automobiles are eliminated from the centre campus. Segregation of vehicles and pedestrians is achieved. In such a system, service access must still be provided to the central campus.

The University of Chicago Circle Campus is an example of axial planning with a functional allocation of uses. Classrooms, administration space and laboratories for each discipline are grouped together in separate structures. The axes of growth are defined at the pedestrian level of movement. Ground level circulation is left primarily for vehicles. The central organizing feature is an agora on the roof of the lecture room block which provides a place for informal gatherings and formal meetings in good weather.

San Mateo Junior College

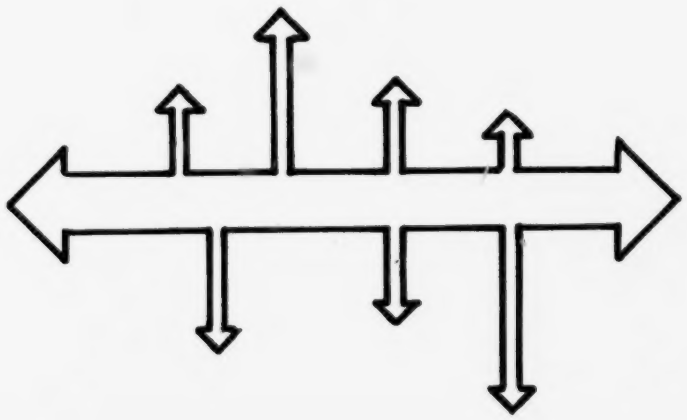


University of Illinois, Chicago Circle Campus, Chicago, U.S.A.



Linear

In some respects, linear growth is a type of axial growth. The difference being that a linear development has a single spine and hence only one principle direction of growth, from the ends of the spine. The sub-systems, departments, functions, colleges, etc., can develop, within limits, at right angles away from the spine. Development of this type is limited by the availability of new land and by the ease of interaction from one end to the other.

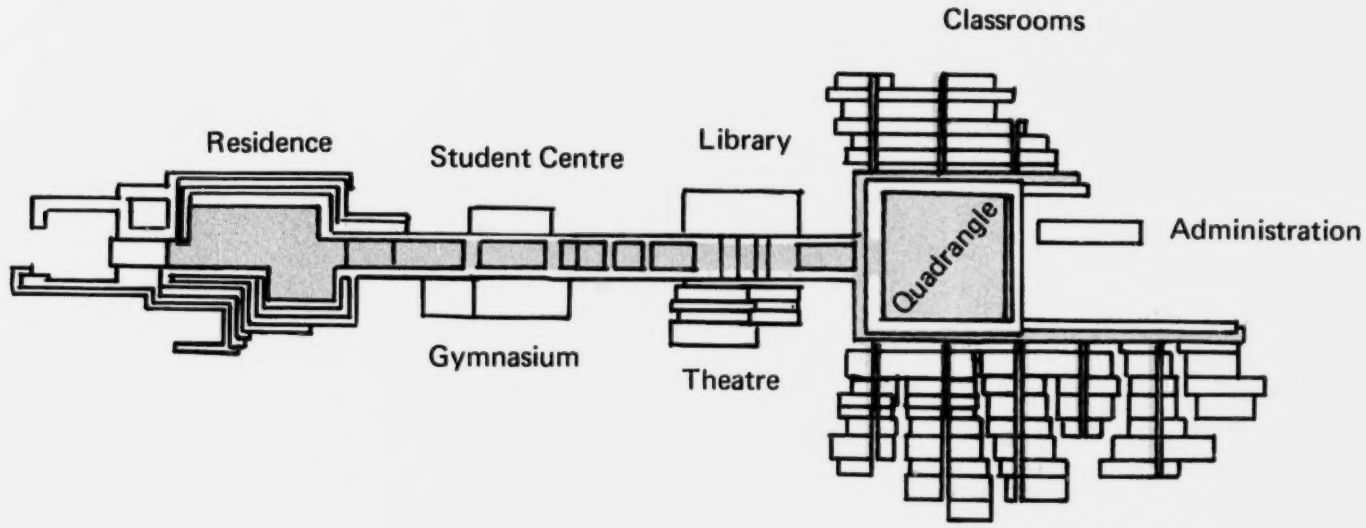


Simon Fraser University is an example of the use of a linear growth pattern to encourage the overlapping and merging of traditional disciplines. The spine stretches from student residences at one end to the quadrangle of teaching spaces at the other. The major communal facilities, library, gymnasium, theatre and ballroom are plugged into the spine at intermediate locations. Pedestrian vehicular traffic is segreated vertically. A transportation centre is located in an intermediate point in the spine. Parking garages are provided at the lower levels under the pedestrian mall.

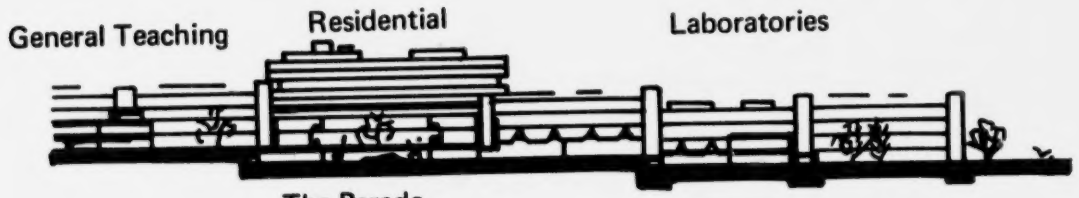
The University of Bath in England uses linear development for a departmental academic program. The central spine which is called the parade, is where the most static communal spaces of the campus are located. These are residences and the general teaching spaces of each school or department. The less determined and more heavily serviced spaces branch off from either side of the parade.

The master plan is organized to allow easy addition of elements without disruption of the existing campus until the student population reaches 5,000. Each growth element contains a central use facility such as a theatre, some communal facilities which the planners have defined as group centres (student union), and restaurant bases. These are located along the parade. Each school has a communal nucleus bordering on the parade.

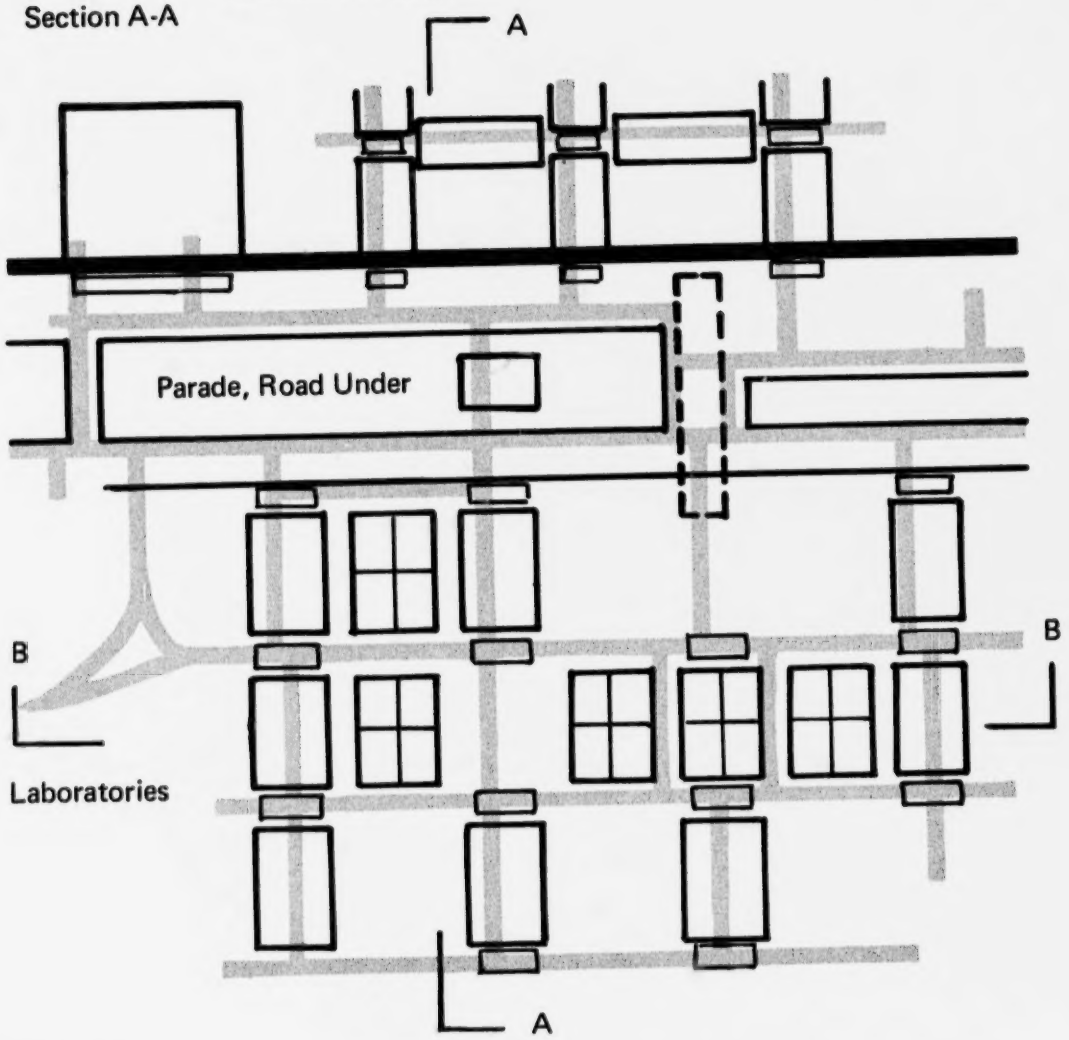
Simon Fraser University, British Columbia, Canada



University of Bath, England



Section A-A

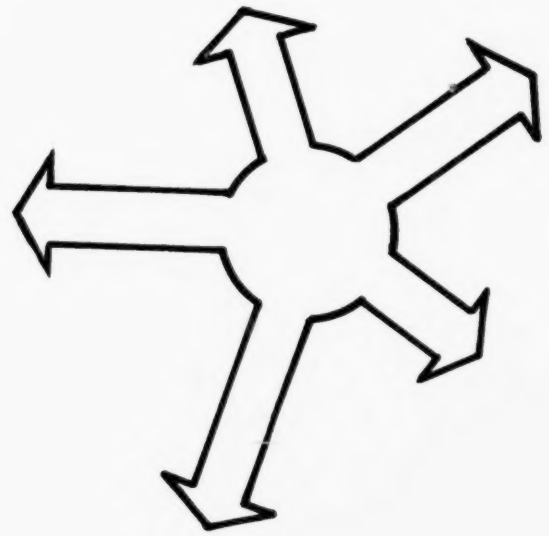


Section B-B

Radial Growth

Radial growth patterns depend on the establishment of a strong central core. Secondary elements connect directly with the core at one end, providing close contact with the centre and with the other elements. The other end of each element projects into the landscape and has a sense of detachment from the whole complex. The axial type of expansion at the outer ends is possible without disrupting the college life at the centre.

The core could be compared to an agora or market place in old towns. It is the point where all paths cross to create a maximum of social inter-action; it is here that the communal facilities of the college are located.

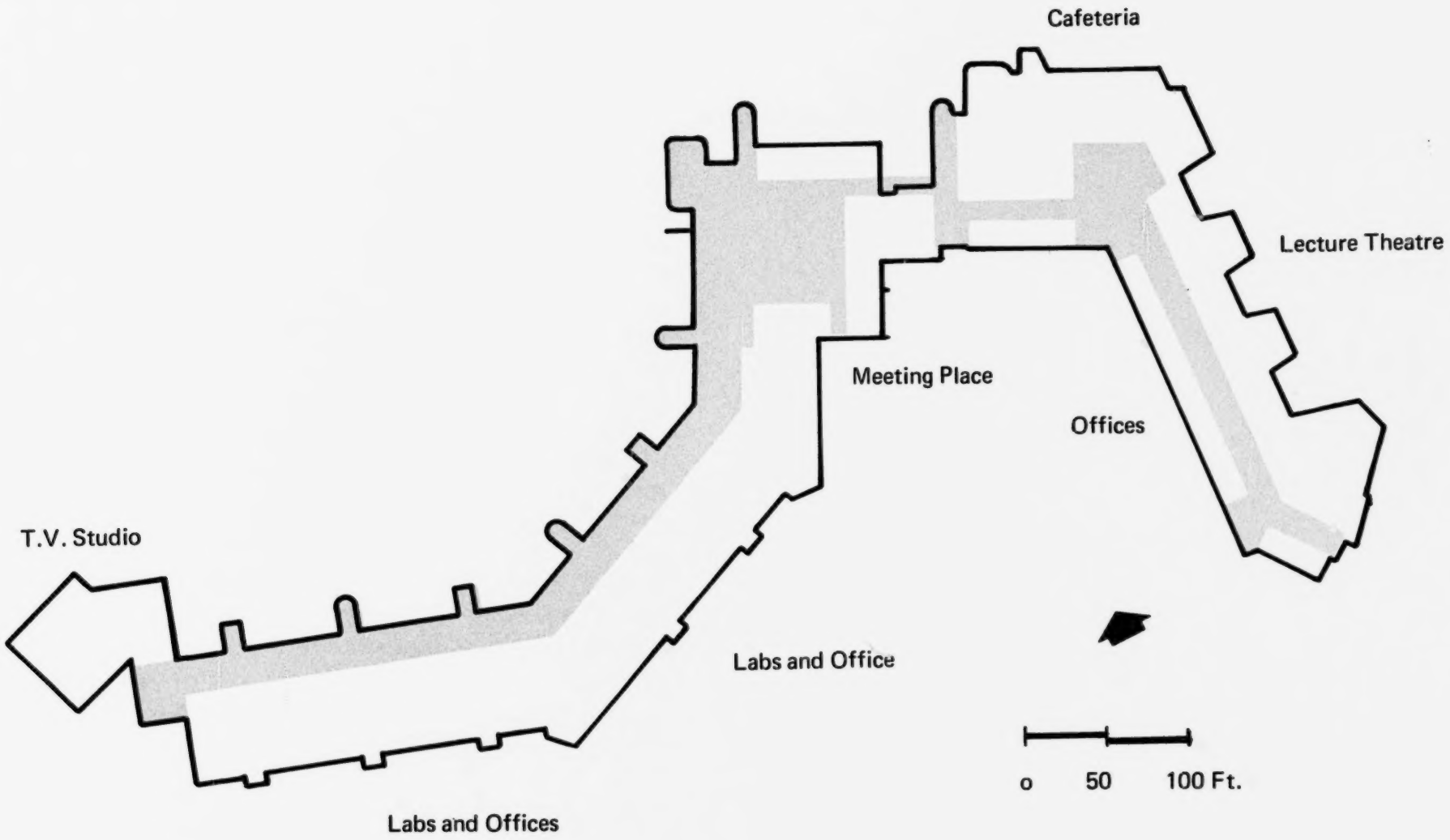


At Scarborough College (Phase One), the central focus is the meeting place off which are ranged the administrative offices. The meeting place itself provides the social focus for the college and is immediately adjacent to the cafeteria, book store and library facilities. The wing extending to the west houses the science group, laboratories, lecture theatres, faculty offices and research labs. The east wing is devoted to the humanities — the large auditoriums, large and small lecture theatres, and faculty offices. Extension to the college can be made by additions to the existing wings and by adding new linear elements.

The new campus at Irvine California also uses a radial principle of growth but in a very different context. The plan is in the form of a giant wheel with a 30-acre park as the hub and six spokes radiating from it. Each spoke is arranged axially within itself. The principal spoke contains all the general use facilities — library, student centre and administration buildings. In the other quadrangle spokes, maximum usage buildings are located nearest the hub. Moving away from the centre are found graduate facilities, research laboratories and housing. Athletic facilities are on the periphery.

Additions to the campus are made initially by adding "spokes" until the circle of six quadrangles has been completed. Each quadrangle element can grow outwards from the centre. At the perimeter of the wheel there will also be room for lateral extensions. However, the campus becomes very sprawling and the distances across the diameter tend to be too great to allow easy inter-action. The hub where the central life of the campus would be expected to be found is empty. The provision of a thirty-acre core park permits future extension of the central facilities inwards.

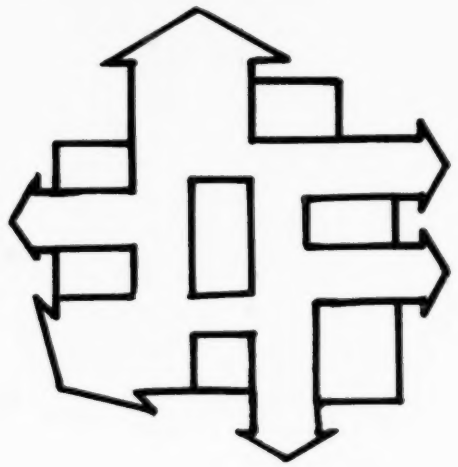
Scarborough College, University of Toronto, Ontario, Canada



University of California, Irvine Campus, California, U. S. A.

Precinctual

In the precinctual form of campus organization the complex is broken down into balanced components. The idea is to have equality of component importance. There is no major feature in the pattern. The components may consist of functions, departments, or be elements containing all features of university life. Growth can be developed in any direction because there is no central focus to which elements have to be directly related.



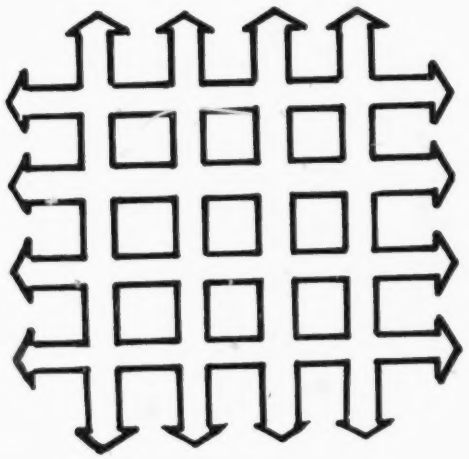
The University of York in England adopted a precinctual growth pattern to accommodate a tutorial academic program. There is no central campus in the traditional sense. A number of nodes were created so that facilities would be within a circle whose radius represents five minutes walking time. The nodes have a tri-part structure, each having one central-core type facility (library, theatre, student union) to help establish its identity and to ensure maximum communication between the nodes. The second element contains facilities that require limited flexibility — residences and general purpose teaching space such as small lecture and seminar rooms. The third element is for facilities requiring extensive internal flexibility, such as teaching spaces and research facilities. This is located on the periphery of the sub-group so that it can be easily expanded.

The campus was planned to allow a serial development of the total complex. Since each node is complete within itself, the campus can be developed in self-contained stages.

University of York, England

Cellular /Grid

Cellular growth patterns place an emphasis on flexibility. The essence of the cellular approach is to devise a basic grid related to building dimensions and pedestrian movement systems. The grid is spread across the whole site. If the site is enlarged the grid is simply extended. The advantage of this approach is that the system has the potential capacity for random extension. Many growth patterns are possible within the basic dictates of the grid. If a use in the centre of the site grows, the system permits adjacent facilities to slide outwards across the grid or contract to allow for the expansion of the central elements.



At Loughborough in Leicester, England, the concept calls for the spaces within the grid to be flexible. The inherent problem with this type of design is a loss of functional efficiency of areas because they can not be designed for a specific use. This consideration has to be balanced against the advantages of being able to convert any space to any use.

Initial construction costs tend to be high because the structure and services must be designed to accommodate unforeseen uses. The high initial cost may be off-set by lower remodelling expenses. The grid system is particularly suitable where capital building funds are granted in relatively small amounts; small units can be gradually and easily added to the system as needed.

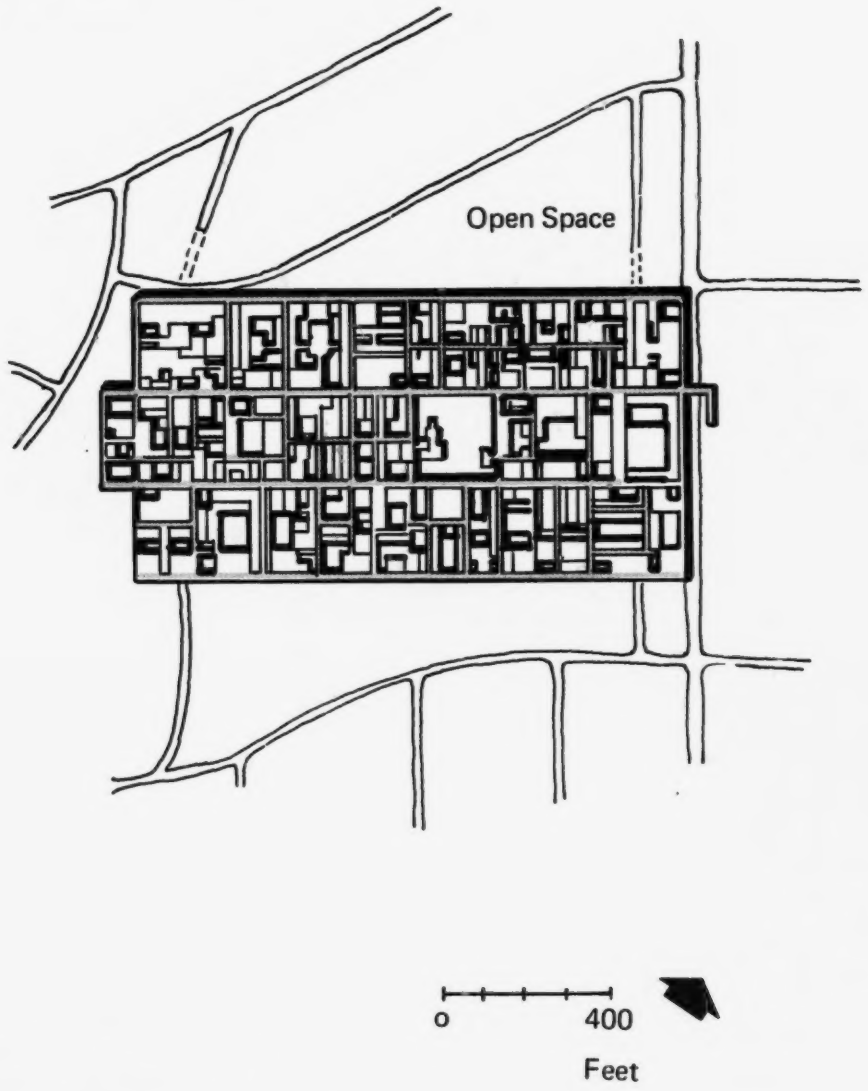
When this cellular /grid approach is used for the master plan, the designs may avoid creating any strong central focus on the campus. Major use facilities can be distributed throughout the area. On the other hand a hierarchy of centres may be developed throughout the grid. The campus plan leads to an informal atmosphere and architecturally it results in an intimate scale of building.

There are two basic types of grid: directional and non-directional grid. The Berlin Free University is an example of a directional grid. The master plan emphasizes the circulation system across the length of the site. A primary system of pedestrian routes 16 feet wide run parallel to each other across the entire campus. At right angles to the main arteries are eight foot wide secondary circulation paths. These are introduced as required. The pedestrian ways are on two levels and both levels are covered.

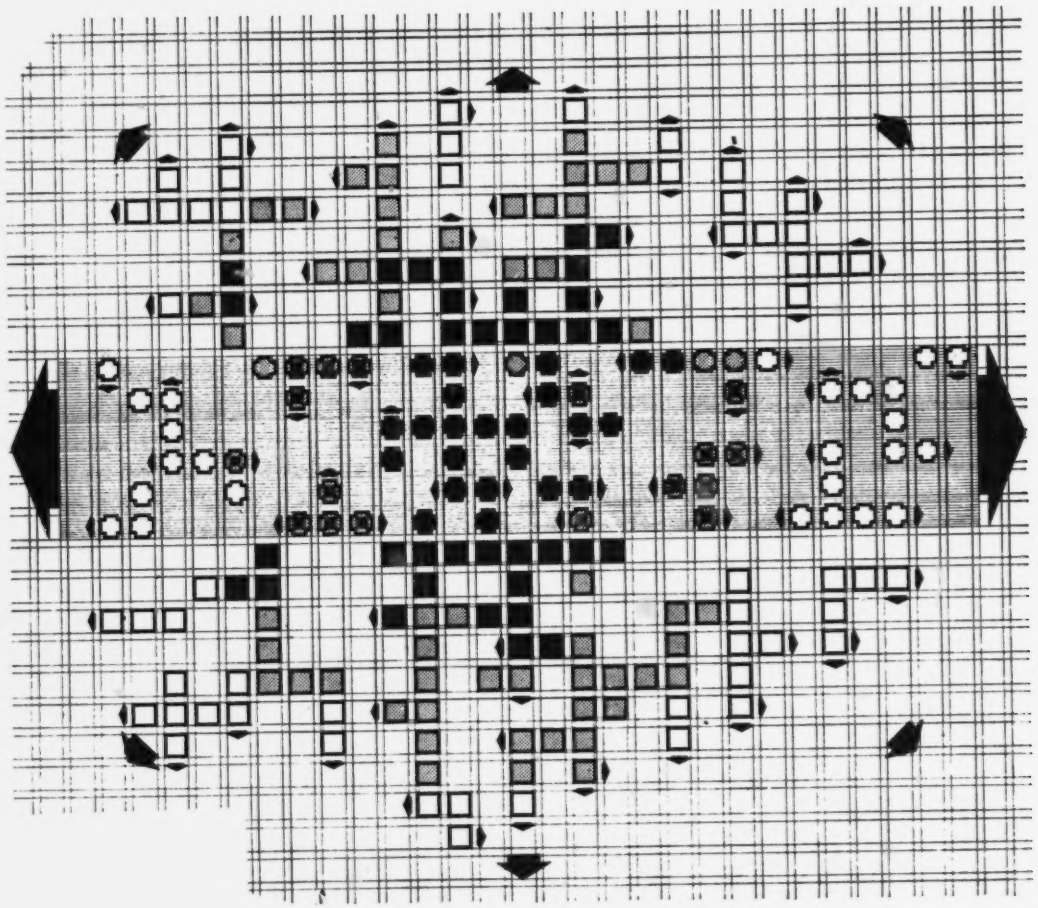
The planners deliberately avoided creating a central focus because they felt that it would limit the flexibility and growth of their concept. The campus is organized on a departmental basis. Larger, short-term use facilities, such as lecture halls, are located off the primary pedestrian routes, and smaller, longer-use areas, such as laboratories, seminar rooms and offices are located off the secondary pedestrian paths.

At Loughborough, a non-directional grid has been employed. Fifty-foot divisions with 15-foot corridors between were set out in both directions. The 50-foot grid was developed through the design of an economic uninterrupted structural span and the determination of a specific room dimension. The 15-foot grid was developed for services. Pedestrian movement is planned to circulate through the buildings themselves.

Berlin Free University, Berlin, West Germany



Loughborough University, Leicester, England



MOVEMENT PATTERNS

The design of a campus master plan involves the efficient accommodation of a number of different types of movement systems. This section of the report is limited to some aspects of the primary pedestrian movement patterns within the complex and with only that part of the campus that is primarily associated with the academic program of the college. However, the existence of other movement systems cannot be ignored since decisions concerning one type of movement will have a real effect on other types.The campus is also linked to the wider community through its connections with the internal movement systems.

Vehicular

The desire for limitation of vehicular movement within the campus has already been noted. Therefore, in the following sections, it is assumed that private vehicles are excluded from the campus. However, it should be noted that if the campus sprawls extensively, some type of vehicular transport may be required to quickly convey people from point to point. In addition, vehicular access to some parts of the campus may be necessary to serve the special needs of official visitors and the handicapped.

Vehicular movement patterns involve storing vehicles that arrive at the campus. If the college has a large proportion of students commuting by car, parking occupies major land area. (A parked car takes up about the same area as a private study bedroom.) The location of terminal parking facilities will obviously influence pedestrian movement.

Service vehicles will have to penetrate the complex to deliver equipment and supplies and to remove refuse. There are a variety of design solutions that will permit the necessary servicing and still maintain a desirable pedestrian environment. Possible solutions to the problem range from occasional use by service vehicles of pedestrian malls as roads, to underground service tunnels, or the raising of the pedestrian level to allow free access for vehicles underneath.

Information

The problem of communication, both inter-departmental and between all elements of the complex and the community must be considered and defined at an early stage in the planning process. The type of academic program and the teaching methods used may require both open and closed-circuit television networks. Link-up with a central computer system may be desirable both for administrative and teaching purposes.

Services

If there is a central heating plant there will be a duct system to provide heat distribution. Heating ducts may be located under pedestrian paths to minimize snow removal problems.

All buildings on campus will require connections to the electrical, water and sewer systems. Science laboratories may require special supply systems for chemicals and gases and special heavy duty waste disposal systems.

Some service systems are directly related to the communications network. All buildings will require telephone installations. Other types of communication services may include regular and closed circuit television cables, cable links to a central computer, and telex.

All service installations must be considered in relation to the growth patterns. This is so that connections to new buildings can be made naturally and economically, and so that service routes are not restricted in their future growth. The design of the service system must also permit easy access for maintenance.

PEDESTRIAN MOVEMENT

The pedestrian movement system in a college or university has the following primary functions: to establish access to and linkage between elements, to provide informal meeting situations, and to ensure that ramps and elevators for the use of the elderly and the handicapped are provided.

Pedestrian circulation along various movement channels is associated with the changeover between classes. With timetabled classes, it is a straightforward matter to compute the volumes of pedestrian movement. Maximum figures assume 100 percent attendance. If the academic structure calls for much private study, the situation becomes complex and the estimation of movement volumes is a matter of informed and intelligent guesswork, at least until some specialist devises a formula.

The character of movement is directly related to the volumes involved. Naturally, the surge of a thousand students leaving a lecture hall will be an entirely different situation than, say, the changeover of five research fellows in a laboratory.

Movement spaces must have the capacity to cope with peak loads without congestion. This involves the spaces within the sub-system — vestibules, corridors, elevators and staircases.

Movement volumes must be compatible with the surroundings. A thousand students cannot erupt into a zone where quiet is a primary environmental criterion, but five research fellows would not create a major disturbance in such a zone.

Movement volumes can be manipulated to a certain degree. A group of a thousand students may exit into a lobby designed for that capacity or there might be four different exit points which would break the flow into four 250 volumes.

The academic or social event associated with the movement pattern is an integral part of the physical design considerations. The movement pattern of a thousand students leaving a basketball game is totally different than the pattern formed by the same number leaving a church service. In the latter case, it might be desirable to quickly disperse the flow in order to maintain a meditative atmosphere. In the former case, it could prove disturbing to exit from an exciting athletic atmosphere into a pacific environment.

The creation of atmosphere is an architectural problem involving the manipulation of spaces, volumes, scale, acoustics, light and texture. Within any campus complex there should develop a wide variety corresponding to the many different activities of the campus.

Pedestrian movement patterns and growth patterns are interdependent. The normal class time pattern allows a ten-minute interval for students to change classrooms. The student has to collect his belongings, put on a coat, leave the classroom, move to another room and sit down within this time span. Normal walking speed is 250 feet per minute. If five minutes are allowed for actual walking, then no student can be expected to travel more than 1,750 feet between classes. This does not mean that 1,750 feet is the limit of any campus development, but that movement patterns have to be carefully studied to ensure that a student is not being asked to make an impossible journey between classes. In ordinary situations it has been found that, in general, people are willing to walk for ten minutes. If the trip is longer than this, they will seek some type of vehicular transport.

Axial

In the traditional type of axial campus plan, pedestrian linkage between elements becomes the unifying design feature.

Axial and linear types of movement patterns lead to heavy concentrations of pedestrian traffic on main walkways. This results in a tendency for malls to develop an expressway character — you can wave to someone but the press of people discourages stopping to talk. Therefore, frequent areas are required where people can step aside to converse.

At San Mateo College the planners have provided large terraces spaced frequently along the main access to encourage informal meeting situations. The terraces are located at the points of greatest activity, the climate being conducive to lingering outside. Because the site slopes, the paths have been ramped to accommodate the changes in level. Terraces are co-ordinated with ramp locations to exploit the magnificent views that can be seen from the campus.

Colonnaded walkways emphasize the linking characteristic of the malls and formal landscape planting emphasizes the directional character of the malls. The peripheral road allows vehicular access to all buildings, thus leaving the interior of the campus entirely for pedestrian movement.

The use of elevated pedestrian ways at the University of Illinois Chicago Circle Campus accentuates the linkage function of the axes. Informal meeting situations are confined to the central square since there are no other places to withdraw from the movement flow. In the central space a small amphitheatre has been created which provides an ideal place for students to talk or hold large meetings.

Since pedestrian movement has been elevated, the ground level becomes available for vehicles. It is also possible for pedestrians to "short circuit" the formal elevated routes since secondary informal pedestrian movement is possible at ground level.

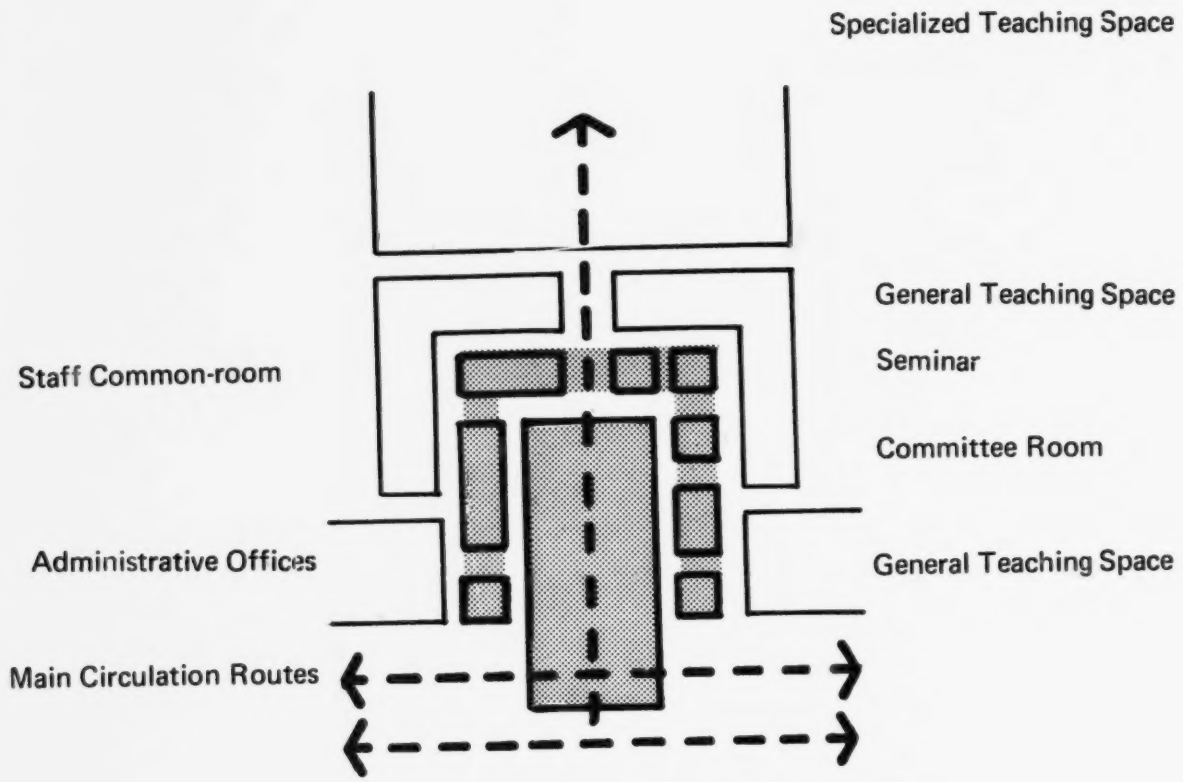
Since this is entirely a commuter campus, large car parking areas are provided on the periphery. At present, these are completely divorced from the campus movement systems. There is a nearby rapid transit stop and the high-level pedestrian routes give direct access to the station.

Linear

At both Simon Fraser University in British Columbia and Bath University in England, the pedestrian spine is the basis of the campus organization. Both campuses were conceived as single units. The concentration of movement along the axis has been used to create a lively campus core, and a variety of meeting situations have been carefully designed along the spine.

At Simon Fraser, the lower levels of the central part of the mall provide terminal parking structures for the commuters. Access to the elevated part of the mall is through a series of courtyards off which are located student meeting rooms. The most dramatic communal area is the academic quadrangle which terminates the mall in the form of a huge space-frame area. This indoor/outdoor area is an expression of the architect's concept of the university as a community which learns from both formal and informal interaction. In addition to providing access to the faculty offices and the teaching spaces, the quadrangle is a pleasant place to loiter, providing a variety of sub-areas ideally suited to conversation and informal meeting. Although the entire mall is a communal area, the planners have separated the space into various functions with the teaching quadrangle located at one end, and the residential facilities located at the other. The library and gymnasium are located in the centre.

At the University of Bath, where the central spine is termed "the parade", the architects have sought to achieve a maximum of integration between all types of activities. The parade is the focus of the academic and community life of the campus. Cars and people are separated by elevating the pedestrian space. Group centres, social facilities and restaurants are located along the entire length of the parade. Student and faculty housing blocks span across the spine at four points to give the space a sense of identity and to centralize a portion of the residential accommodation. Those spaces that are communal to the university, for example: administrative offices, libraries and large lecture rooms, are also distributed along the parade. The campus is subdivided into schools of study, and each school has a social nuclei on the parade linking it with the larger university community.


Specialized Teaching Space
General Teaching Space
Seminar
Committee Room
Staff Common-room
Administrative Offices
General Teaching Space
Main Circulation Routes
General Communal Area

Radial

The radial type of movement pattern focuses on a central area. At Scarborough College, this takes the form of a skylighted "meeting place" through which everyone must pass to move from one radial arm to another. The meandering form of the radial arms was determined by the site contours. Access to the enclosed pedestrian "street" is always at grade level, with the meeting place resolving the one storey change in level, between the science and humanities wings. The meeting-place stairs and landing have been designed to provide an informal stage area for large gatherings. On Sunday afternoons this space becomes a community concert hall. Small conversation areas with comfortable lounge furniture are located around the periphery of the lower level of the space. Similar small, informal areas are provided along the humanities "street" opposite the lecture-theatre entrances. These areas have a number of glass doors which can be opened to extend the lounge space to the outside in pleasant weather.

At present, parking is at ground level to the north of the building. A service tunnel runs underground from the parking lot into the basement of the building.

The elements of the radial plan of the Irvine campus are conventional quadrangles. The pedestrian circulation system within each element is axial in character and similar to the San Mateo campus. Vehicular segregation is similarly achieved by planning the road outside the greatest pedestrian movement. Informal meeting areas are designed within each quadrangle and inter-action between quadrangles is intended to take place in the large central park. The California climate permits the extensive use of outdoor areas.

Precinctual

The precinctual approach to planning calls for a dispersal of activities and the avoidance of any strong central feature. The pedestrian movement system and the treatment of spaces between buildings relate the elements to one another.

At the University of York in England the nodal areas are linked by pedestrian walkways so that the linkages are both visual and functional. Visual linkage is created by covering the walkways. Since service ducts are aligned under the pedestrian paths, the linkage is also functional. Most student activity takes place within the triplet element where there are common rooms and dining facilities. Social interaction with the larger university community is encouraged by the need for students to visit other nodal areas to utilize major university facilities.

The northern English climate requires that the major social areas be climate-controlled. The campus has been handsomely landscaped around an artificial lake to provide attractive views from a sheltered area, and the park and gardens allow students to withdraw from academic life in fine weather. Informally landscaped features impose informal rather than structured movement patterns.

Cellular/Grid

In the cellular/grid method of campus planning only the basic structuring principles are established. Since changing concepts of planning and flexibility form the basis of the planning philosophy, no strong centres of activity are created.

At the Berlin Free University the planners sought to encourage inter-departmental mingling and spontaneous social centres throughout the campus. The organization of covered pedestrian routes forms the basic grid and channels the pedestrian movement. However, there is also a system of open green spaces developed throughout the campus fairly independent of the basic grid, which provide relief from the severity of the grid movement system. The green spaces also provide common meeting ground between departments. The complex is serviced by an underground vehicular system.

The movement patterns at Loughborough are perhaps more structured. Pedestrian movement is directed through the buildings and outdoor spaces in an integrating pattern which tends to strengthen the relationships between elements. Informal meeting areas can be created by developing some of the 50-foot square sites as courtyards. Social facilities, student union, restaurants, meeting rooms, etc., will be dispersed throughout the complex. Pedestrian vehicular segregation is achieved by vertical separation of traffic systems.

FOOTNOTES

1. A. E. Sloman, *A University in the Making*, British Broadcasting Corporation, 1964, p. 51
2. *Higher Education, The Report of the Committee Under the Chairmanship of Lord Robbins*, H.M.S.O., 1965, Chapter 2, Para. 28
3. Bullock, Dickens, Steadman; *op. cit.*, p. 15

ACKNOWLEDGMENTS

San Mateo Junior College San Mateo, California, U.S.A. 1961
Architect/John Carl Warnecke & Associates
Landscape Architect/Michael Painter
Landscape Architects/Roystow, Hanomoto, Mayes & Beck

University of Illinois, Chicago Circle, Chicago, Illinois, U.S.A.
Architects/Skidmore, Owings, & Merrill, Chicago
Walter Netsch (partner in charge)

Simon Fraser University Burnaby, British Columbia, Canada
Planning, preliminary design, and design of all buildings, site development and landscaping
Architects/Erickson Massey

University of Bath Bath, England
Development Plan — Architects/Planners Robert Matthew, Johnson-Marshall & Partners

Scarborough College, University of Toronto, Scarborough, Ontario, Canada
Co-ordinating Architect/John Andrews
Landscape Architects/Michael Hough
Architects (stage one)/Page & Steele in association with John Andrews

University of California, Irvine Irvine, California, U.S.A.
Architects and Planners/William L. Pereiria & Associates
Landscape Architects/C. Jacques Hahn and J. Charles Hottman with Frederick H. Lang and Robert H. Carter & Associates

University of York York, England.
Development and Architects/Robert Matthew, Johnson-Marshall and Partners

Berlin Free University Berlin, West Germany
Architects/Candins, Woods & Josic
Architect in Charge/Shadrach Woods

Loughborough University of Technology Leicester, England
Master Plan/Arup Associates